Computer-aided Quantitative Analysis of Diagnostic Electromyography

CLINICAL ELECTROMYOGRAPHY (EMG) is extremely useful in evaluating patients with neuromuscular diseases. During that part of the study involving the examination of muscles with intramuscular needle electrodes, a physician engages in a dynamic, interactive process with a patient as the data are recorded. In conventional EMG, interpretation is subjective and the results are reported in descriptive terms.

Manual methods of EMG quantitation have existed for many years but have not been adopted into routine practice because the benefits are outweighed by the disadvantages of being tedious and time-consuming. In the past few years, however, with the availability of equipment with rapid digital processing capabilities, strong interest has developed in the quantitative analysis of needle EMG. Software programs have been developed that offer a range of possibilities in two broad categories of analysis, namely the quantitation of motor unit action potentials and the interference pattern. In analyzing the motor unit action potentials, the potentials are extracted from the ongoing EMG signal and any of the following variables may be measured—peak-to-peak amplitude, number of phases, number of turns, duration, rectified area within the defined duration, the ratio of area to amplitude, and firing pattern. Studies are usually done on low-threshold motor units recruited during low-level contractions, although some programs permit the extraction of action potentials at higher force levels. The simplest programs assist the operator by measuring the motor unit action potentials, but the electromyographer still must record and display the individual potentials. More advanced programs will extract, identify, and measure motor unit action potentials, providing considerable saving of operator time and effort. Automatic analysis of the interference pattern may include measurements of baseline crossings, peaks, turns, amplitude of deflections, turns-to-amplitude ratio, and the frequency spectrum of the signal.

Reference data recorded from normal subjects are available for some of these measures, especially motor unit action potential analysis at low efforts and analysis of the turns:amplitude ratio of the inference pattern. Comparable reference data for the other measures are being reported as more experience is gained with them. It is relatively easy for electromyographers to develop their own laboratory norms because the equipment has become standardized and the software easier to use.

The opportunity for easy quantitation of the EMG signal will influence the way electromyographers approach diagnostic EMG in those patients in whom pathophysiologic changes are most apparent on needle examination, such as those with generalized disorders (myopathies and denervating diseases). Conventional EMG examinations, performed by observation, analyzed subjectively, and reported descriptively, will remain acceptable practice in routine diagnosis. Automatic quantitation, however, allows a more detailed and thorough analysis of the pathophysiology of the disease process and hence a more valid basis for diagnosis. The severity of a disease process is quantifiable, and the presence of special or unusual features, such as mixed patterns in some patients with inflammatory myopathies, can be recognized. Quantitation of the EMG offers considerable advantage over conventional subjective EMG interpretation for detecting the progression of disease in follow-up studies.

Despite the technical advantages of computer-aided quantitative analysis, it is still not possible for a technician to independently record an EMG for the subsequent interpretation by a physician. On the contrary, EMG examination is now more demanding of physicians who must remain attentive to the details of the technique and the proper use of equipment. Computer-aided quantitative EMG analysis provides clinical electromyographers an additional array of specific procedures, any of which may be selected to enhance the diagnostic study in any given patient.

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Deep Vein Thrombosis in Patients With Spinal Cord Injury

PATIENTS WITH ACUTE SPINAL CORD INJURY are highly prone to the development of deep vein thrombosis. Deep vein thrombosis delays rehabilitation, prolongs hospital stays, and hence increases the cost of care. Important complications are pulmonary embolism, which is often fatal, and the post-thrombosis syndrome with permanent swelling and edema in the leg. The factors contributing to the high incidence include stasis following paralysis and immobility, hypercoagulability of blood, tissue trauma, and infection. The risk is greatest in the first three months after injury and declines after six months. During the acute phase, an increase in the platelet responsiveness to collagen and an increase in the ratio of factor VIII antigen to factor VIII C has been reported.

The reported incidence of deep vein thrombosis in patients with spinal cord injuries has been decreasing during the past decade because of earlier admissions to hospital, better diagnostic methods, and aggressive prophylaxis or therapy, but it still remains in the range of 10% to 25%. Clinically, contrast venography remains the gold standard of definitive diagnosis, although radionuclide scanning is also an accurate means of diagnosis, has the added advantages of detecting pelvic vein thrombosis and active heterotopic ossification, and can be used on a limb with a cast.

A prophylactic regimen in current use includes fixed-low-dose subcutaneous heparin (5,000 units every 12 hours), adjusted-dose subcutaneous heparin to keep the activated partial thromboplastin time (PTT) at a desired level, low-dose warfarin sodium, pneumatic compression and aspirin, pneumatic compression alone, and functional electrical stimulation alone or in conjunction with any of the above. Fixed-dose subcutaneous heparin is the most commonly used regimen. It can reduce the incidence of calf vein thrombosis substantially compared with that in patients not given prophylaxis. The failure rate, however, for a fixed-dose regimen has been reported to be 10% to 31%. An adjusted-dose regimen aimed at maintaining the activated PTT (six hours after the evening dose) at 1.5 times the control value has reduced the incidence of deep vein thrombosis to 7%, but hemorrhagic complications occurred in 24% of the patients.

The current clinical approach of choice to prophylaxis